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METHOD FOR PROCESSING PARABOLIC ANTENNA MIRROR SURFACE PLATE

Inventor:	Koichi Takita Omiya Plant, Yagi Antenna Co., Ltd. 1406 Hasunuma, Omiya-shi, Saitama-ken
Applicant:	000006817 Yagi Antenna Co., Ltd. 1-6-10 Uchikanda, Chiyoda-ku, Tokyo
Agents:	100058479 Takehiko Suzue, patent attorney, and 5 others

[There are no amendments to this patent.]

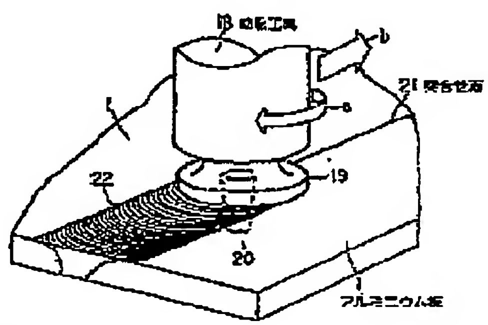
Abstract

Purpose

To make excess metal finishing and plate distortion removal at joints unnecessary, to improve the strength and the quality of the joints, to improve the reliability, and to lower the cost.

Solution

A wide flat plate 23 is prepared by joining aluminum plates 1 by a friction stir joining method. In other words, the joining surfaces of several aluminum plates 1 to be joined are secured in a butted state, and while a rotary tool 18 is rotated at high speed, a projecting part 20 is inserted into butted surfaces 21 from a side of the aluminum plates 1 and run at a fixed speed. At that time, the aluminum material is raised to the recrystallization temperature by the friction between the projecting part 20 and the butted surfaces 21 of the aluminum plates 1, and the butted surfaces 21 of the aluminum plates 1 are bonded by mixing atoms through substitution. The wide flat plate 23 prepared by the above-mentioned friction stir joining method is processed into a parabolic shape by pressing or drawing, so that a parabolic antenna mirror surface is manufactured.



Key: 1 Aluminum plate
18 Rotary tool
21 Butted surface

<u>Claims</u>

1. A method for processing a parabolic antenna mirror surface plate, characterized by the fact that a wide flat plate is prepared by joining several aluminum plates using a friction stir joining method, with said wide flat plate being processed into a parabolic shape by drawing, so that a parabolic antenna mirror surface plate is manufactured.

2. A method for processing a parabolic antenna mirror surface plate, characterized by the fact that a wide flat plate is prepared by joining several aluminum plates using a friction stir joining method, with said wide flat plate being processed into a parabolic shape by pressing, so that a parabolic antenna mirror surface plate is manufactured.

Detailed explanation of the invention

[0001]

Technical field of the invention

The present invention pertains to a method for processing parabolic antenna mirror surface plates in which a parabolic antenna mirror surface plate is manufactured by joining and processing aluminum plates.

[0002]

Prior art

Aluminum plates are generally used as mirror surface plates for parabolic antennas. In joining the aluminum mirror surface plates, several aluminum plates are joined by MIG or TIG welding to prepare a mirror surface plate for a parabolic antenna with a large diameter of 2 m or more. The aluminum plate is then processed into a parabolic shape by drawing or pressing, so that a parabolic antenna mirror surface plate is obtained.

[0003]

Figure 7 shows a state in which several plates, for example, three aluminum plates 1 are welded by a conventional welding method such as MIG or TIG welding. Figure 8 is a detailed diagram showing a weld joint 2. If the aluminum plates 1 are welded by the conventional welding method, a top face excess weld metal part 3 and a back face excess weld metal part 4 are formed at weld joint 2, as shown in detail in Figure 8.

[0004]

Figure 9 shows a state in which the top face excess weld metal part 3 and back face excess weld metal part 4 of the above-mentioned weld joint 2 have been finished by a grinder, etc. In Figure 9, 5 is the finished top face excess weld metal part, and 6 is the finished back face excess weld metal part.

[0005]

Problems to be solved by the invention

If the aluminum plates 1 are relatively small, the top face excess weld metal part 3 and the back face excess weld metal part 4 of the weld joint 2 can be finished to a plane surface, as shown in Figure 9, by grinding, etc.

[0006]

If large aluminum plates 1, such as mirror surface plates for a large-diameter parabolic antenna, are welded, the welding is carried out by automatic welding, etc., since the welded parts of the aluminum plates 1 are long. However, defects are easily generated in the welded parts. Also, since the aluminum plates 1 are large, it is difficult to fix the welded parts horizontally over the entire length, and even if they are fixed horizontally by a fastener such as jig (a height difference within 0.2 mm), a step difference part 7 in the top face weld joint and a step difference part 8 of the back face weld joint are generated in the welded part 2, as shown in Figure 10, by the welding heat that causes thermal expansion of the material during welding. These step difference parts 7 and 8 are finished along with the top face excess weld metal part 3 and the back face excess weld metal part 4 by a grinder, etc. However, a very large amount of time is required for the finishing process, and it is very difficult to finish the entire surface uniformly. Since it is necessary for the above-mentioned stepped parts 7 and 8 to be very smoothly processed horizontally, as shown in Figure 11, the plate is thinned too much during the finishing so that the strength of the thinned part 9 is weakened, thereby generating cracks during drawing. Also, if defective welded parts exist, cracks are similarly generated. Also, since it is necessary to match the design strength of the mirror surface plate with the welded part strength and it is necessary to compensate for the strength decrease in the welded parts by increasing of the strength of the entire mirror surface plate, the mirror surface plate must be thickened so that the material cost is greatly increased.

[0007]

The present invention solves the above-mentioned problems, and its purpose is to provide a method for drawing an aluminum alloy welding material that makes excess metal finishing and plate distortion removal at joints unnecessary, improves the strength and the quality of the joints, improves the reliability, and lowers the cost.

[0008]

Means to solve the problems

The method for processing a parabolic antenna mirror surface plate of a first invention is characterized by the fact that a wide flat plate is prepared by joining several aluminum plates using a friction stir joining method, with said wide flat plate being processed into a parabolic shape by drawing, so that a parabolic antenna mirror surface plate is manufactured.

[0009]

The method for processing a parabolic antenna mirror surface plate of a second invention is characterized by the fact that a wide flat plate is prepared by joining several aluminum plates using a friction stir joining method, with said wide flat plate being processed into a parabolic shape by pressing, so that a parabolic antenna mirror surface plate is manufactured.

[0010]

Embodiment of the invention

Next, an embodiment of the present invention is explained with reference to the figures. In the present invention, a wide flat plate is prepared by joining aluminum plates 1 by using a friction stir joining machine 11 shown in Figure 1, and the wide flat plate is processed into a parabolic shape by pressing or drawing, so that a parabolic antenna mirror surface plate is manufactured.

[0011]

Figure 1 shows the constitution of the friction stir joining machine 11 in simplified form. In the figure, 12 is a bed for processing that is sized such that the width and the length are suitable for the size of the material to be joined. On the above-mentioned bed 12, several aluminum plates 1 to be joined are placed, and for example, four corners are secured by fixing mechanisms (not shown in the figure).

[0012]

Also, a friction stir joining mechanism 13 is installed above the above-mentioned bed 12 to be movable in the longitudinal direction of the bed 12. Also, in Figure 1, the mechanism for holding the friction stir joining mechanism 13 and the mechanism for driving it in the longitudinal direction are omitted. In the above-mentioned friction stir joining mechanism 13, several, for example, three, servo motors 15 are installed on a holding plate 14, and drills 16 rotated by the above-mentioned servo motors 15 are installed below the holding plate 14. These drills 16 comprise rotors 18, installed at the tips of holding tubes 17, for joining the aluminum plates. The rotors 18 have hard joint disks 19 at the tips, as specifically shown in Figure 2, and have projecting parts 20 with a diameter suited to the thickness of the plates to be joined in the center of the joint disks 19, and are rotated at a speed suited to the thickness of the plates to be joined in the direction of arrow a.

[0013]

Next, the processing operation will be explained when the aluminum plates 1 are joined using the above-mentioned friction stir joining machine 11. As shown in Figures 1 and 2, several, for example, two aluminum plates 1 to be joined are placed on the bed 12 so that the mirror top face will be the lower side, and with the joining surfaces butted, each corner part, for example, is fixed. In this state, the rotors 18 are rotated at high speed by the servo motors 15, the projecting parts 20 are inserted into the butted surfaces 21 from a side of the aluminum plates 1, and the joint disks 19 are driven at a fixed speed in the direction shown by an arrow b while they are in contact with the upper surfaces of the aluminum plates 1. At that time, the aluminum material is raised to the recrystallization temperature, such as about 400°C, by the friction between the projecting parts 20 and the butted surfaces 21 of the aluminum plates 1, and the butted surfaces 21 of the aluminum plates 1 are bonded by mixing atoms through substitution. At that time, the upper surface of the joint 22 is made planar by the joint disk 19, and the lower surface is pressed against the upper surface of the bed 12, so that a mirror surface shape is formed.

[0014]

The above-mentioned friction stir joining method is different from the conventional welding joining method, and since the aluminum plates 1 do not reach a very high temperature and a slight amount of heat is exhibited only in a narrow range of peripheral contact with the rotor 18, it is not necessary to reliably secure the entirety of the aluminum plates 1 and the welding zone. Appropriate portions, for example, of the four corners of the periphery of the aluminum plates 1 can be fixed, and fixing the joint locations is not required. Also, since the rotor 18 contacts the surfaces to be joined while pressing them and the amount of heat is not very great, the joint 22 is not distorted or elongated by a thermal expansion, and joining is made possible without fixing the surfaces to be joined.

[0015]

As mentioned above, several aluminum plates 1 are joined by the friction stir joining machine 11, so that a wide flat plate 23 is prepared, as shown in Figure 3. Figure 4 is an enlarged diagram showing the stirred part of the above-mentioned joint 22. As shown in Figure 4, the upper surface of the joint 22 is made planar by the joint disk 19, and the lower surface is pressed against the upper surface of the bed 12 and formed into a mirror surface.

[0016]

Next, the wide flat plate 23 in which the above-mentioned several aluminum plates 1 are joined by the friction stir joining method is drawn by a drawing die 31, as shown in Figure 5. Since the wide flat plate 23 joined by the above-mentioned friction stir joining method does not deform as with the welding bonding, it is not necessary to apply distortion correction to it even when it is removed from the bed 12, and the wide flat plate can be placed as is in the drawing die (or pressing die).

[0017]

As shown in Figure 5, the wide flat plate 23 is first placed on the upper part of the drawing die 31, and its central part is fixed to the drawing die 31 by a bolt 32. In this case, the mirror top face of the wide flat plate 23 contacts the drawing die 31. Then, while rotating the drawing die 31 in the direction shown by an arrow c, pressure is applied to the upper surface of the wide flat plate 23 by a drawing roller 33. Furthermore, the drawing roller 33 is moved along the drawing die 31 as shown by an arrow d, and the wide flat plate 23 is drawn so that a parabolic antenna mirror surface plate 34 with a parabolic shape is formed as shown in Figure 6.

[0018]

Figure 6(a) is a front view showing the above-mentioned parabolic antenna mirror surface plate 34, and (b) is a side sectional view showing part of it. In this embodiment, an example in which a curled part 35 is formed along the outer periphery of a parabolic antenna mirror surface plate 34 has been shown, but other shapes can also be formed. Also, the above-mentioned curled part 35 can be formed separately from the parabolic antenna mirror surface plate 34 and fixed to the outer periphery of the parabolic antenna mirror surface plate 34 by rivets, etc. Furthermore, the above-mentioned curled part 35 may not need to be provided.

[0019]

As mentioned above, since the wide flat plate 23 is formed by joining several aluminum plates 1 using the friction stir joining method, no excess metal part is formed in the joint 22, and no distortion is caused. Thus, inspection of the joint 22 can be greatly simplified, and a skilled technician is not required. Also, when the above-mentioned joint 22 is placed in the pressing or drawing die and processed into a mirror surface with a parabolic shape, joint defects and defects due to finishing of the joint do not exist. Thus, cracks are not generated in the joint 22 during the pressing or drawing process, and there are no drawing defects due to the roller jumping over a finishing defect during the drawing process. Furthermore, since the joint 22 is not

work-hardened, the joint 22 adheres to the die, and the parabolic shape is precisely formed so that mirror surface modification is not required.

[0020]

Also, since it is not necessary to finish the joint 22, it retains sufficient strength, so that it is not necessary to match the design strength to the joint strength. The joint can be designed in accordance with the strength of the parent material, so that the mirror surface plate can be formed thin.

[0021]

Because of the above various advantages, the material cost and the processing time can be reduced, and the reliability of the joint 22 can be improved, so that a product with improved quality and a beautiful appearance can be easily manufactured. Also, the above-described embodiment involved a parabolic antenna mirror surface plate 34 molded using a wide flat plate 23 composed of three aluminum plates 1, but the number of aluminum plates 1 used is optional. Also, in the above-described embodiment a parabolic antenna mirror surface plate 34 was formed by drawing the wide flat plate 23, but needless to say the parabolic antenna mirror surface plate 34 could also be formed by pressing the wide flat plate 23.

[0022]

Effects of the invention

As described above in detail, according to the present invention, a wide flat plate is formed by joining several aluminum plates using the friction stir joining method, and the wide flat plate is formed into a parabolic antenna mirror surface plate with a parabolic shape by pressing or drawing. Thus, the excess metal finishing of the joint and the removal of distortions in the plate are not required, cracks are not generated in the joint, and the strength and the quality of the joint can be improved, so that the reliability can be improved and the cost can be reduced.

Brief description of the figures

Figure 1 is an oblique view showing in simplified form the constitution of a friction stir joining machine used in processing a parabolic antenna mirror surface plate in an embodiment of the present invention.

Figure 2 shows the joining rotor of the friction stir joining machine and the joined state of an aluminum plate in said embodiment.

Figure 3 shows a state of a plate that has been joined by the friction stir joining method in said embodiment.

Figure 4 is an enlarged diagram showing a joint formed by the friction stir joining method in said embodiment.

Figure 5 shows the process of drawing the mirror surface plate in said embodiment.

Figure 6(a) is a front view showing a completed parabolic antenna mirror surface in said embodiment, and (b) is a side sectional view showing part of said parabolic antenna mirror surface.

Figure 7 is an oblique view showing a mirror surface plate joined by a conventional welding method.

Figure 8 is a cross section showing details of a welded part in Figure 7.

Figure 9 shows the condition when excess weld metal parts of a mirror surface plate joined by the conventional welding method have been finished.

Figure 10 shows a state in which step differences have been generated in the welded parts of the mirror surface plate joined with the conventional welding method.

Figure 11 shows a state in which the mirror surface plate in which step differences were generated in Figure 10 has been finished.

Explanation of symbols

1 Aluminum plate
11 Friction stir joining machine
12 Bed
13 Friction stir joining mechanism
14 Holding plate
15 Servo motor
16 Drill
17 Holding tube
18 Rotor
19 Joint disk
20 Projecting part
21 Butted surface
22 Joint
23 Wide flat plate
31 Drawing die
32 Bolt
33 Drawing roller
34 Parabolic antenna mirror surface plate
35 Curled part

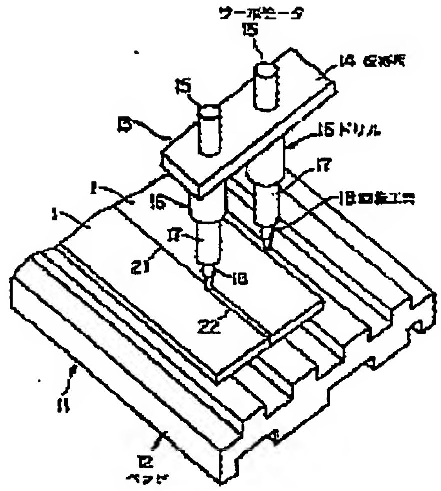


Figure 1

Key: 12 Bed
14 Holding plate
15 Servo motor
16 Drill
18 Rotor

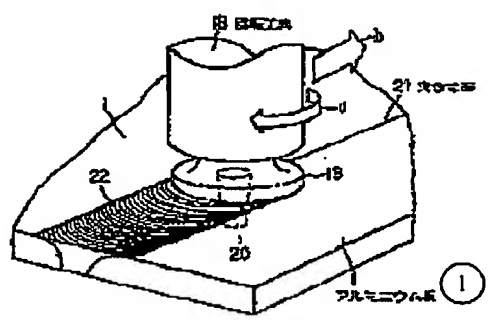


Figure 2

Key: 1 Aluminum plate
18 Rotor
21 Butted surface

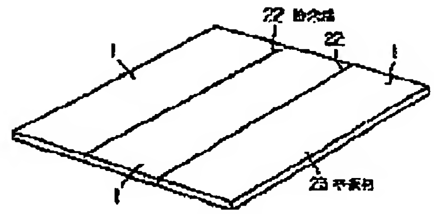


Figure 3

Key: 22 Joint
23 Wide flat plate

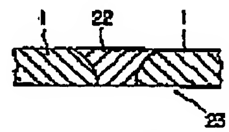


Figure 4

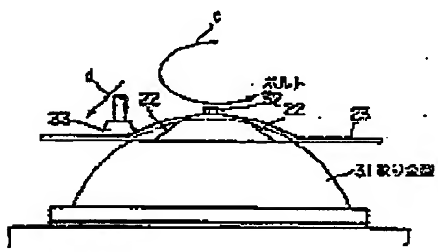


Figure 5

Key: 31 Drawing die
32 Bolt

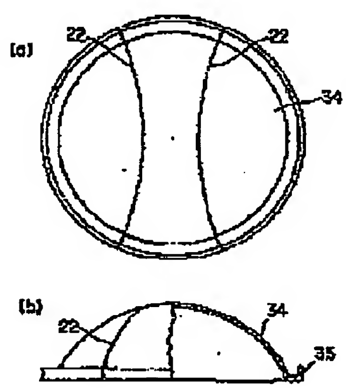


Figure 6

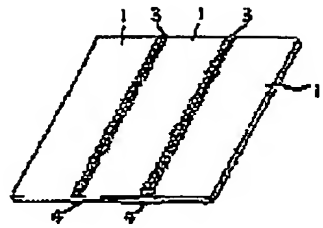


Figure 7

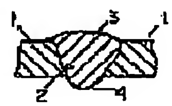


Figure 8

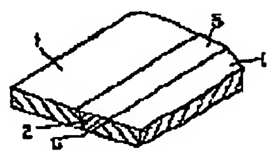


Figure 9

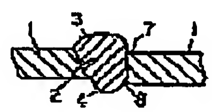


Figure 10

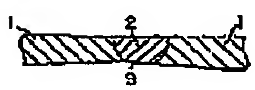


Figure 11